Neutrino beam

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and

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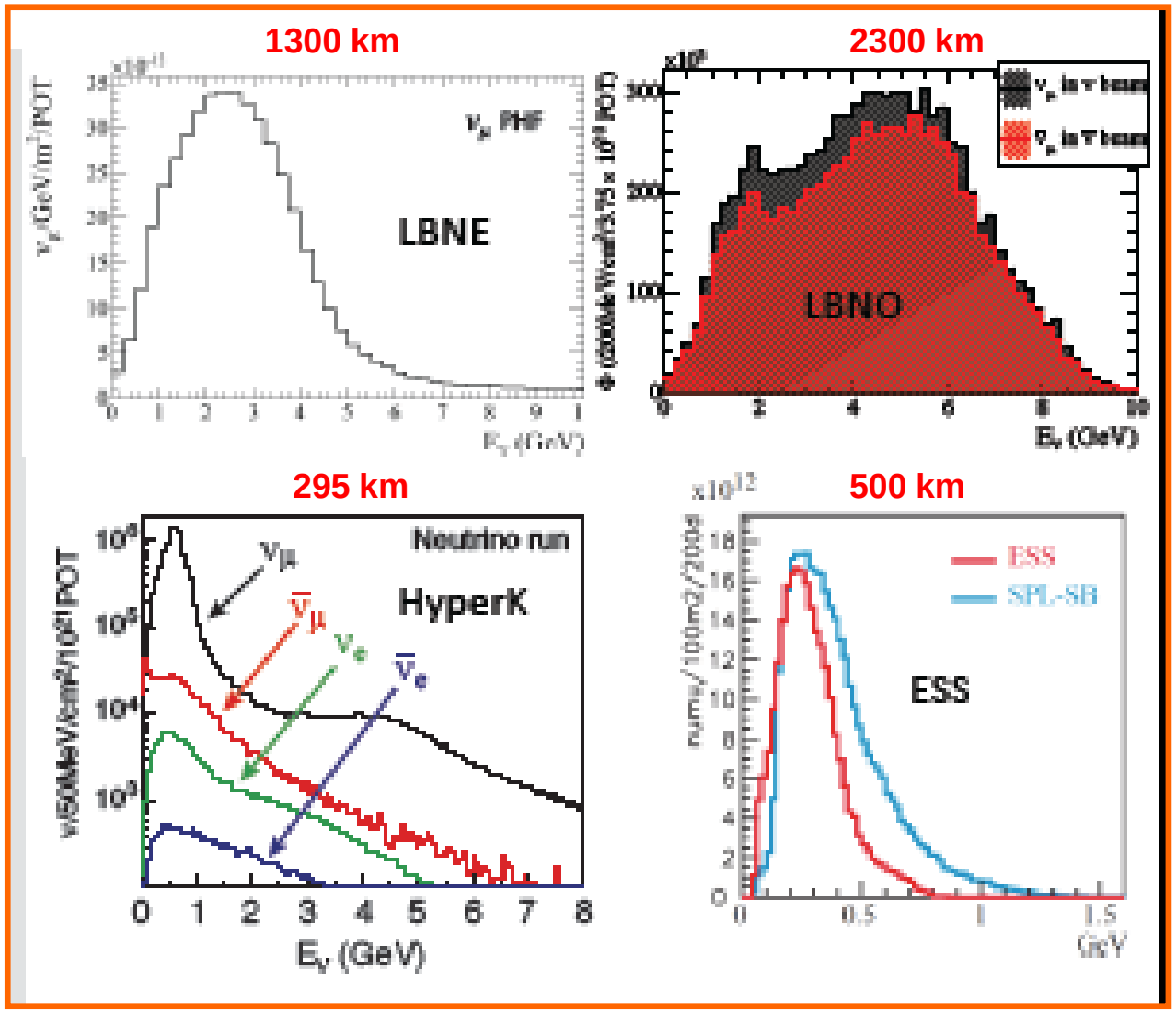
iiEB meeting, FNAL, 23 September 2014

Beams for LBL experiments

1st + 2nd?



1st + 2nd

1st

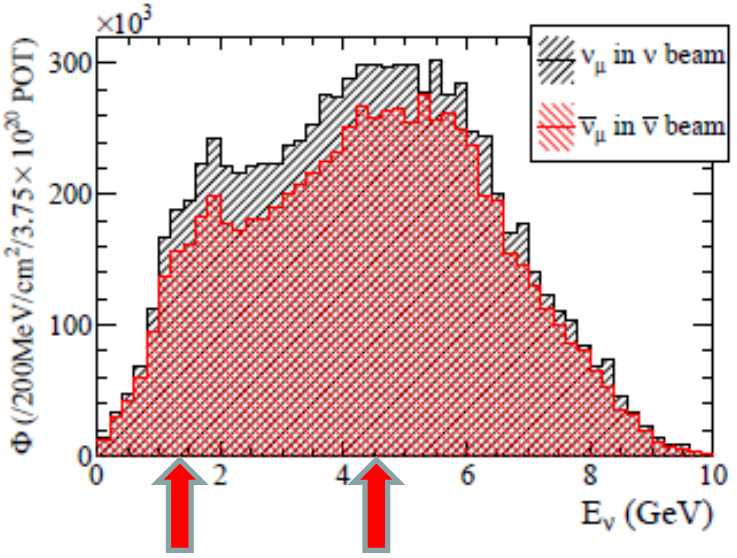
2nd

LBNO CPV sensitivities

LBNO CERN to Pyhasalmi
neutrino and antineutrino
unoscillated fluxes

L = 2300 km

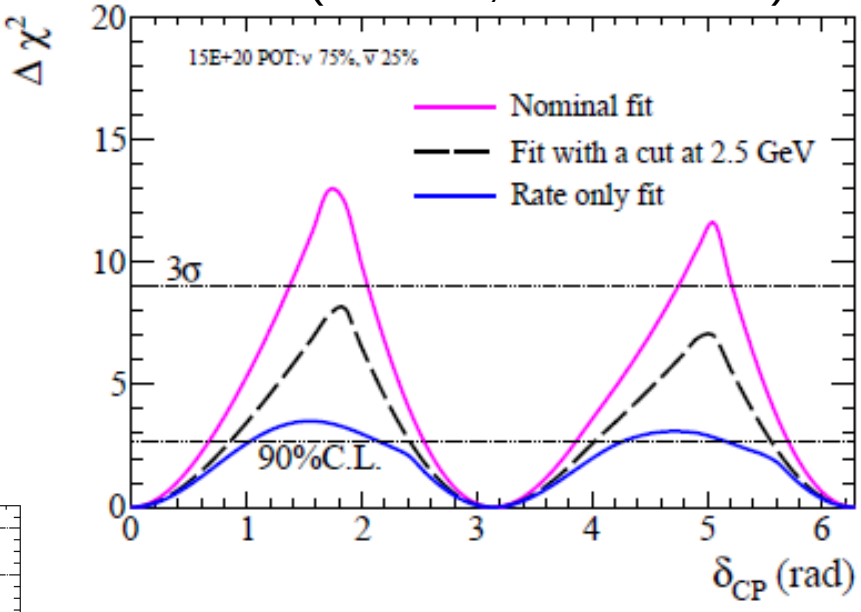
1.5×10^{21} POT SPS 750 kW



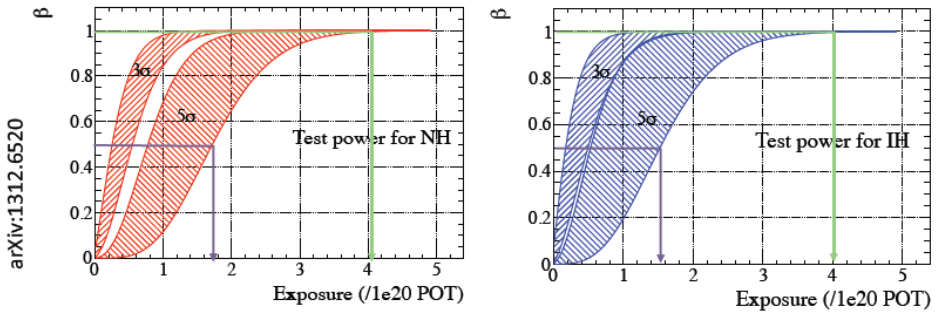
2nd 1st

Normal Hierarchy

(75% - ν, 25% - anti-ν)



Cut at 2.5 GeV removes
2nd oscillation peak

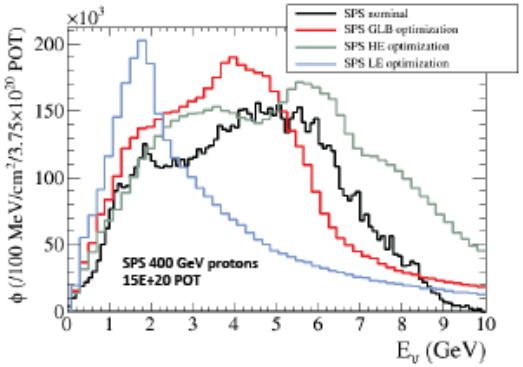


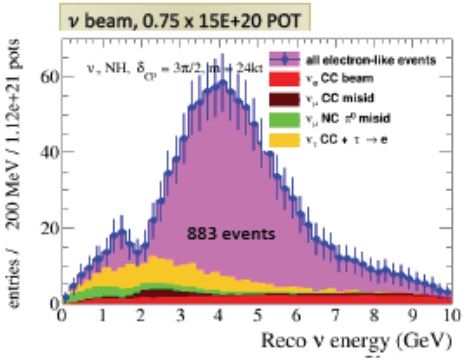
LBNO measure MH with >5σ level

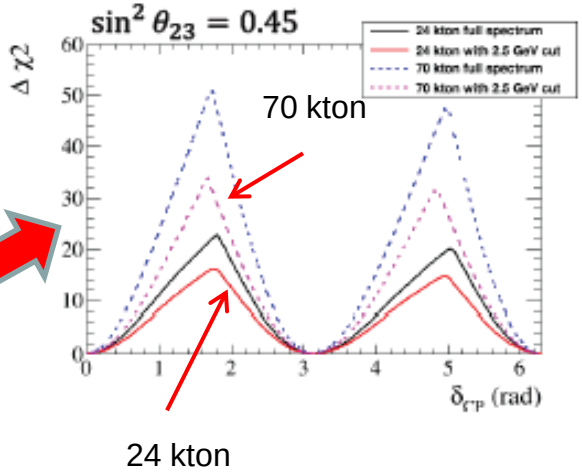
Second oscillation maximum and L/E for LBNO

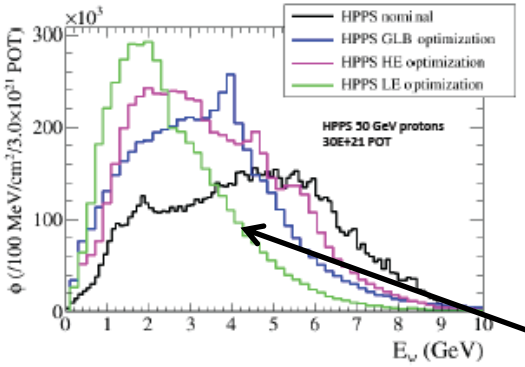
Normal Hierarchy

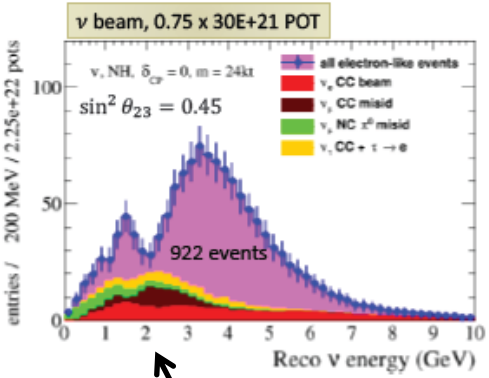
SPS beam

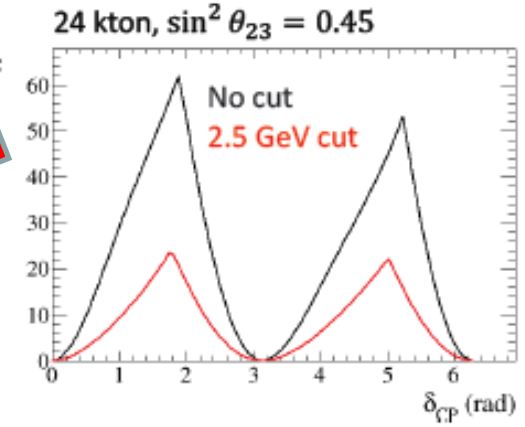










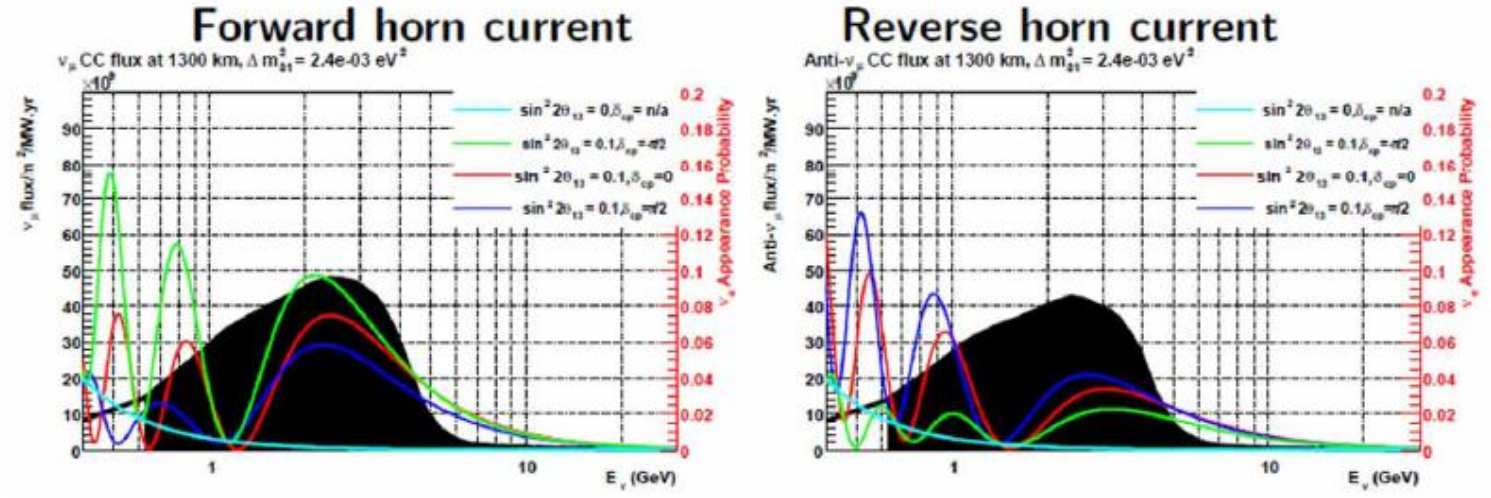


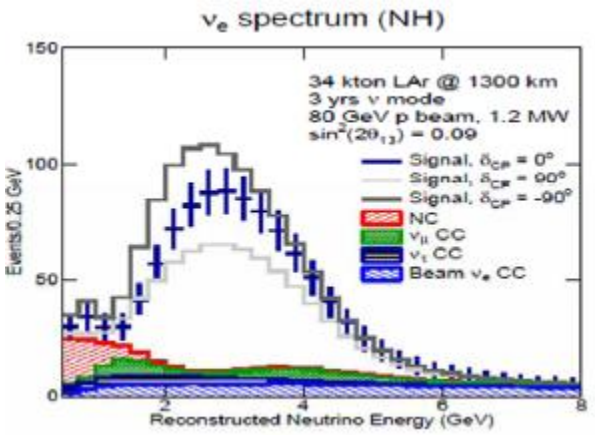
Best CPV coverage is obtained for "SPS GLB" and "HPPS LEOP]

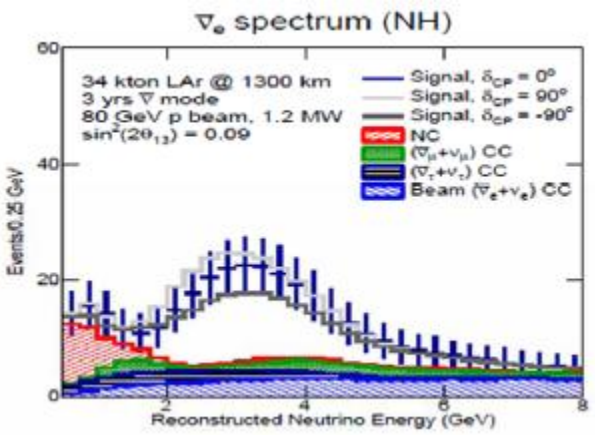
HPPS LE beam

LBNE beam

Optimized beam: 80 GeV, Be target 84cm long -25cm from Horn 1, NuMI horns 230kA, 6.6m apart, 6m* x 250m He filled DP:



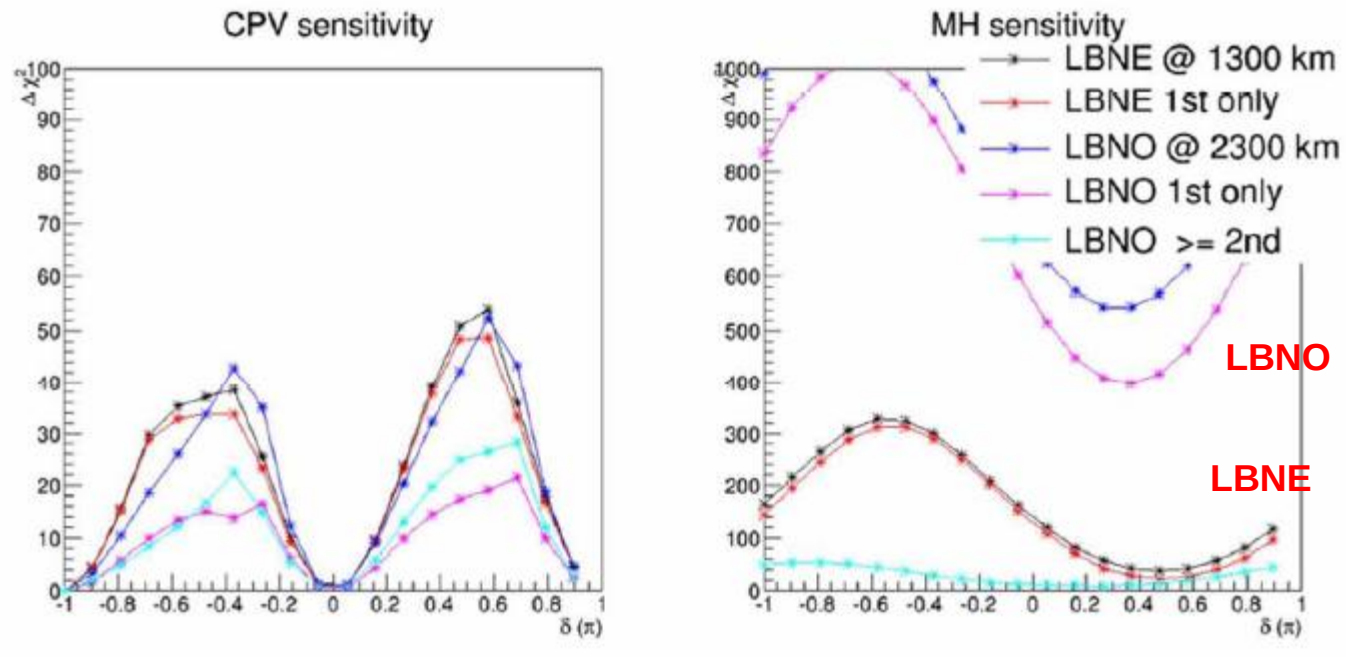




LBNO and LBNE sensitivities

LBNO Sensitivity is calculated with
HPPS LE beam
50 GeV beam + 24 kt + 32.7e21 POT
3.9E25 GeV kt POT

LBNE Sensitivity is calculated with
2010 beam
120 GeV beam + 34 kt + 8.6e21 POT
3.5E25 GeV kt POT



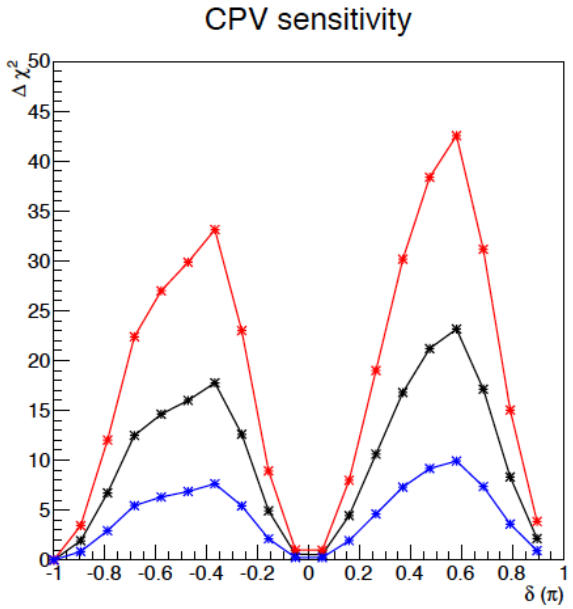
J.Strait, LBNO meeting, Aug 2014

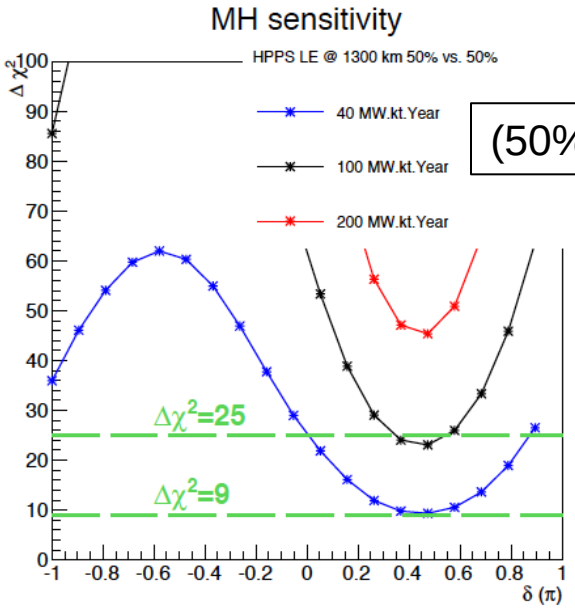
2nd oscillation maximum is not important in LBNE with baseline of 1300 km

HPPS LE beam at 1300 km

LBNO LE neutrino beam from 50 GeV HPPS LE was used for simulations at 1300 km

LBNE Collaboration





(50% - ν, 50% - anti-ν)

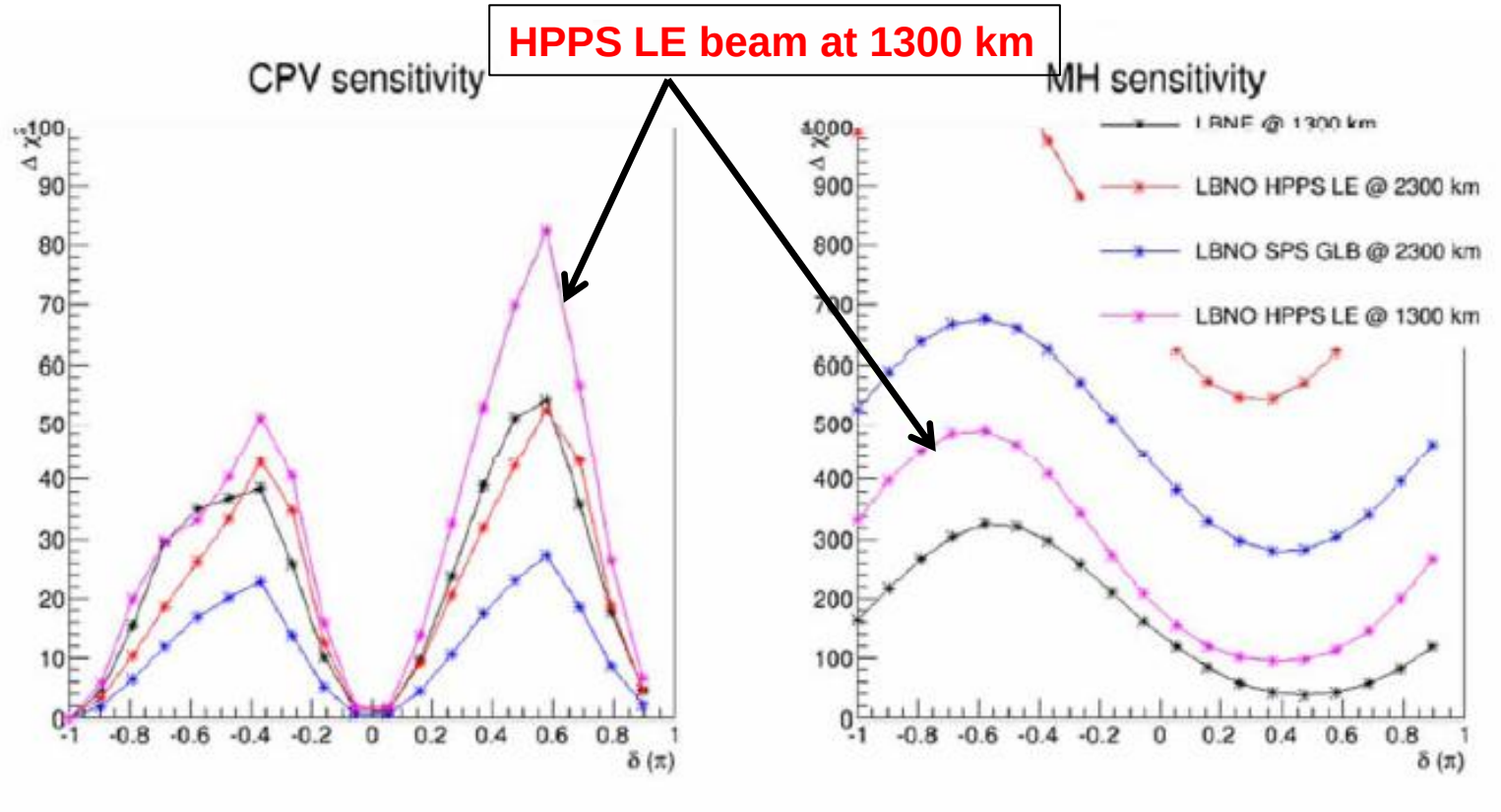
MH, 5 sigma @ 100%, NH
1300 km: 128.442 kt-MW-yr for 5 sigma
2500 km: 23.3859 kt-MW-yr for 5 sigma

MH, 5 sigma @ 100%, IH
1300 km: 122.665 kt-MW-yr for 5 sigma
2500 km: 25.0334 kt-MW-yr for 5 sigma

MH, 3 sigma @ 100%, NH
1300 km: 44.8644 kt-MW-yr for 3 sigma
2500 km: 14.0315 kt-MW-yr for 3 sigma

MH, 3 sigma @ 100%, IH
1300 km: 41.517 kt-MW-yr for 3 sigma
2500 km: 15.02 kt-MW-yr for 3 sigma

HPPS LE beam at 1300 km



LBNO detector, baseline 1300 km, sensitivity to CPV increased

Beam issues

LBNF: 1300 km baseline

- **A beam option to cover 1 and 2 oscillation maximum should be carefully studied**

- **Power of 2nd oscillation maximum, its importance at 1300 km**

- **L/E behavior, systematics issues, detailed optimization for MH and δ_{CP}**

- **Look into beam options that have been abandoned in the past for cost reasons**

- **New ideas that are now emerging to be seriously analyzed within next few months**